REMARKS

This Preliminary Amendment cancels, without prejudice, claims 1 to 9 in the underlying PCT Application No. PCT/EP2005/000792 and adds new claims 10 to 21. The new claims, inter alia, conform the claims to United States Patent and Trademark Office rules and does not add any new matter to the application.

In accordance with 37 C.F.R. § 1.125(b), the Substitute Specification (including the Abstract) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to United States Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. §§ 1.121(b)(3)(ii) and 1.125(c), a Marked-Up Version of the Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

The underlying PCT Application No. PCT/EP2005/000792 includes an International Search Report, dated March 16, 2005, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

It is respectfully submitted that the subject matter of the present application is new, non-obvious and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully submitted,

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[11150/97]

METHOD AND DEVICE FOR ACTIVATING AN ELECTRIC PARKING BRAKE

FIELD OF THE INVENTION

The present invention relates to a method and a device for activating an electric parking brake of a motor vehicle, ~~in particular~~ **e.g.,** a road motor vehicle.

BACKGROUND INFORMATION

~~From DE~~ **German Published Patent Application No.** 198 38 886 ~~A1~~ **describes** an electric immobilizing brake or parking brake for a vehicle ~~is known~~. The driver of the motor vehicle activates the electric parking brake via a push-button switch, for example. The parking brake ~~ensures~~ **provides** that the vehicle is no longer able to move in the stopped or parked state. To achieve the immobilizing braking effect, it is possible, for ~~instance~~ **example**, to control the parking brake's wheel brakes ~~situated~~ **arranged** on the wheels of the motor vehicle by electromotor/transmission units designed to self-lock. This ~~realizes~~ **provides** the effect of a conventional mechanical immobilization brake.

Activation of the electric parking brake requires electric energy, which can be drawn from the vehicle electrical system. When turning off or parking the motor vehicle, in particular on inclines, it is important that the electrical energy is available at all times. Otherwise it may happen that the vehicle is not reliably protected from unintended rolling. Dangerous situations may occur as a result, in particular in motor vehicles in which the mechanical power of the drive motor is additionally utilized to activate a service brake of the motor vehicle. If after shut-down of the drive motor the electrical energy in such vehicles is no longer sufficient to restart the drive motor, the vehicle is no longer fully controllable.

To avoid such situations, ~~DE~~ **German Published Patent Application No.** 198 38 886 ~~A1 proposed~~ **describes** to provide an auxiliary battery whose energy, as a minimum, is sufficient to activate the parking brake. Disadvantageous in an auxiliary battery provided in addition to the battery of the vehicle electrical system is the effort and expense it entails with regard to construction and production. Also, it is possible once again that the auxiliary battery will no longer have sufficient energy or is unable to store sufficient energy.

SUMMARY

~~It is an object~~ **Example embodiments** of the present invention ~~to~~ provide a method and a device for activating an electric parking brake of a motor vehicle, which **may** allow reliable stopping of the motor vehicle during parking.

~~The subject matters of the independent Claims 1 and 6 constitute achievements of this objective. Advantageous further developments are indicated in the respective dependent claims.~~

According to an ~~essential idea~~ **example embodiment** of the present invention, a drive motor of the motor vehicle is to be turned off only after activation of the electric parking brake when parking the motor vehicle. In this ~~way~~ **manner,** the mechanical energy of the drive motor may still be used for the activation, ~~in particular~~ **e.g.,** by the drive motor driving a generator and using for the activation the electrical energy produced by the generator. This allows the motor vehicle to be parked securely even when the energy store of the vehicle electrical system is low.

It ~~is expediently~~ **may be** detected that the shut-down operation is initiated, and the parking brake is activated subsequently.

For ~~instance~~ **example**, it is possible to monitor whether the vehicle driver gives a signal for turning off an ignition system of an internal combustion engine. The turn-off is implemented only when the parking brake is activated.

~~In particular~~ **For example,** when a generator mechanically coupled to the drive motor is used to generate electrical energy, no modifications with respect to conventional electrical wiring systems of motor vehicles ~~will~~ **may** be required. ~~Specifically~~ **For example**, no auxiliary battery ~~is~~ **may be** necessary to activate the electric parking brake. Instead, ~~the present invention may be realized solely by~~ appropriate ~~design~~ **arrangement** of the control devices in the motor vehicle **may be sufficient**.

A device for activating the electric parking brake has, for ~~instance~~ **example**, an activation device for generating an activation signal that activates the electric parking brake. ~~According to the present invention, the~~ **The** activation device may, ~~in particular~~ **for example**, generate the activation signal automatically, ~~especially~~ **e.g.,** when the motor vehicle is being parked. To this end, a detection device for detecting the initiation of the parking operation is provided. In ~~a development~~ **an example embodiment** of the detection device, it detects the initiation of a shut-down operation for turning the drive motor off. If a conventional ignition lock with ignition key is provided, for example, the vehicle driver turns the ignition key to the "off" position in order to shut down the drive motor. However, the vehicle driver may also give a signal for shutting down the drive motor in some other manner, for ~~instance~~ **example,** by activating an electric push-button switch.

Furthermore, an engine-control device for controlling the shut-down operation is provided in the device. The detection

device is connected to the engine-control device and to the activation device. The activation device and the engine control device are ~~designed~~ **arranged** and combined with each other ~~in~~ such ~~a way~~ that, once of the shut-down operation has been initiated, the activation signal activates the electric parking brake first, the operation of the drive motor being maintained in the meantime, and the drive motor being turned off only afterwards.

It is possible to provide a higher-level control device, which controls the sequence of actions of the engine-control device and the activation device. This higher-level control device may also assume additional tasks such as detecting the initiation of the shut-down operation (i.e., it includes the detection device) and/or additional determinations and/or detections, which will be addressed in more detail ~~later on~~ **below** and on the basis of whose results a decision is made as to whether the drive motor will be utilized to activate the electric parking brake.

The engine-control device, the activation device and/or the detection device may also be integrated in a shared control device. This ~~case~~ is encompassed ~~by the wording~~ **in** that the devices are interconnected.

Although it is possible to shut down the drive motor during each parking operation only after the parking brake has been activated, it ~~is preferred~~ **may be provided** that this be made dependent on one or more of the following criteria:

- The operating state of an electrical energy supply of the motor vehicle. ~~In particular~~ **For example**, a loading state of an energy store of the energy supply is ascertained and/or it is determined whether the energy store is defective. To this end,

an operating-state device for determining the operating state may be provided in the aforementioned device, the operating-state device being coupled to the engine-control device.

- An angle of inclination of the motor vehicle. This criterion is considered satisfied, for ~~instance~~ **example**, when the amount of the angle of inclination is greater than or equal to 8°. With respect to the angle of inclination, it may be differentiated between the roll angle (measured in a plane transversely to the vehicle's longitudinal axis) and the pitch angle (measured in a plane that includes the vehicle's longitudinal axis). ~~Preferably~~ **For example**, solely the pitch angle is considered in the decision as to whether the method ~~according to the present invention~~ will be implemented. A detection device for ascertaining the angle of inclination may be provided in the aforementioned device, the detection device being coupled to the engine-control device.

- Standstill of the motor vehicle. ~~In particular~~ **For example**, it is determined whether all wheels of the motor vehicle are stopped. Signals from rpm sensors, for example, may be analyzed for this purpose. Rpm sensors ~~have the advantage of~~ **may** normally ~~being~~ **be** present in motor vehicles anyway, for ~~instance~~ **example,** in connection with an anti-lock braking system.

The automatic activation of the parking brake with a subsequent shut-down of the drive motor may thus be made dependent on whether the operating state of the electric energy supply requires it, whether the motor vehicle is to be

parked at an angle of inclination that is greater than a minimum angle of inclination, and/or whether the vehicle is at a standstill. In this ~~way the present invention carries out its~~ **manner,** safety ~~function~~ **functions are performed** only when required, and the functionality is not ~~conceived~~ **considered** as distracting. After parking on level terrain, for example, the motor vehicle is thus able to be moved without renewed startup of the drive motor.

The activation of the electric parking brake ~~according to the present invention~~ may be implemented in a variety of ~~ways~~ **manners**. For ~~instance~~ **example**, the operation of the drive motor may be maintained for a period of time having a defined length and starting with the initiation of the shut-down operation and/or the receipt of a corresponding shut-down signal for turning the drive motor off. As an alternative, it is possible, for ~~instance~~ **example**, to first determine whether the parking brake was activated and only then to generate a signal that effects the shut-down of the drive motor. With the first option, it ~~has been shown to~~ **may** be sufficient to maintain the operation of the drive motor over a period of time that lasts at least one second.

~~The~~ **Example embodiments of the** present invention ~~is elucidated in the following on the basis of a preferred exemplary embodiment~~ **are described in more detail below with reference to the appended Figures**.

~~The figures show:~~

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 **is** a schematic representation of a system in a road motor vehicle having an electrical energy supply and including control devices that allow an implementation of ~~the~~ **a** method according to **example embodiments of** the present invention~~;~~ ~~and~~**.**

Fig. 2 **is** a time diagram in simplified form, which ~~shows~~ **illustrates** the chronology of different actions and events in the execution of the method according to **example embodiments of** the present invention.

DETAILED DESCRIPTION

Motor vehicle 1, schematically ~~shown~~ **illustrated** in Fig. 1 within a rectangular frame, has a drive motor 3, which during its operation drives a generator 6 via a mechanical coupling 4. The electrical energy generated by generator 6 is fed into a vehicle electrical system 5, which has at least one energy store for storing electrical energy, ~~in particular~~ **e.g.,** a conventional vehicle battery. Vehicle electrical system 5 is connected to a battery state device 8 (such as a control device for a vehicle electrical system), which is able to determine a charge state of energy store 7, ~~in particular~~ **for example**. A corresponding result of this determination is transmitted to a control device 14 of an electric parking brake (EPB control device in the following text), continuously and/or as required.

Drive motor 3 ~~in the exemplary embodiment is~~ **may be** an internal combustion engine, which ~~can~~ **may** be turned off and on by activating an ignition switch 12. Ignition switch 12 is connected to an engine control device 10, which ~~in turn~~ is connected to drive motor 3. In this ~~way~~ **manner,** engine control device 10 is able to actually take the switching state of ignition switch 12 into account, but not implement a corresponding action directly (i.e., without a time delay). Instead, engine control device 10 may maintain the operation of drive motor 3 as a function of signals it receives from EPB control device 14, notwithstanding ~~the fact~~ that the ignition switch ~~was~~ **is** turned to the "off" position. It is also possible that engine control device 10 decides on its own

whether and/or for how long the operation of drive motor 3 will be maintained.

A separate rpm sensor 15 is ~~shown~~ **illustrated** in the region of the four corners of the rectangular frame in Fig. 1, which is assigned to one of the four wheels of motor vehicle 1 in each ~~case~~ **instance**. In this ~~way~~ **manner,** a movement device 16 (which has a wheel speed evaluator, ~~in particular~~ **for example**) is able to record the rotational wheel speeds of all four wheels. Movement device 16, ~~in particular~~ **for example**, is able to determine whether all four wheels -- and thus vehicle 1 -- are/is at a standstill. Movement device 16 is connected to EPB control device 14, so that EPB control device 14 receives a signal from movement device 16, continually and/or as required, and it is possible to determine from the signal whether the vehicle is stopped.

Furthermore, a detection device 18 is provided, which ascertains an angle of inclination of motor vehicle 1, ~~preferably~~ **e.g.,** the amount of a pitch angle. A corresponding signal is transmitted to EPB control device 14 on a continuous basis and/or as required.

An example of an operation of the system ~~shown~~ **illustrated** in Fig. 1 ~~will now be~~ **is** explained in greater detail with reference to Fig. 2.

First of all, it is assumed that energy store 7 of vehicle electrical system 5 is in a fully functional operating state, i.e., in particular is sufficiently charged to activate an electric parking brake~~, which is not shown further in Fig. 1~~. The activation, with the aid of electrical energy from the vehicle electrical system, may be carried out as described in ~~DE~~ **German Published Patent Application No.** 198 38 886 ~~A1~~, for example, whereas the generation of a corresponding activation

signal is implemented in the manner ~~of the present invention~~ **hereof**.

If ignition switch 12 is switched to "off", EPB control device 14 determines from the signals received from operating state device 8 that energy store 7 carries a sufficient charge. By transmitting a corresponding control signal to engine control device 10 (or by non-transmission of a control signal), engine control device 10 determines that operation of drive motor 3 is able to be terminated immediately, and turns drive motor 3 off.

Accordingly, drive motor 3 is also shut down immediately once ignition switch 12 has been switched off if detection device 18 determines that a predefined amount of an angle of inclination (such as 5° or 8°, for ~~instance~~ **example**) is not exceeded.

~~In an especially preferred specific embodiment, if~~ **If** ignition switch 12 is switched off and motor vehicle 1 is not at a standstill, EPB control device 14 ~~outputs~~ **may output** a corresponding signal to engine control device 10, so that the operation of drive motor 3 will not be terminated (and the electric parking brake will not be activated either) until vehicle 1 is stopped. The method ~~according to the present invention~~ may be implemented in the manner described ~~in the following text~~ **below** as soon as standstill has been reached.

If vehicle electrical system control device 8 detects that the operating state of energy store 7 does not allow reliable activation of the electric parking brake (for ~~instance~~ **example**, that the energy store is defective), if detection device 18 detects that motor vehicle 1 is on steep terrain (the amount of the pitch angle is greater than 5° or 8°, for

example), and if vehicle 1 is stopped, the following actions will be carried out:

When turning ignition switch 12 off at instant t0 (illustrated in Fig. 2 as abrupt decrease in signal 1 from a high level to a low level), EPB control device 14 detects the described state of motor vehicle 1 and outputs a signal to engine control device 10, which induces it not yet to terminate the operation of drive motor 3. This is illustrated in Fig. 2 by a horizontally extending line M, which continues past instant t0 at a high level. At the same time or subsequently, EPB control device 14 outputs a signal to an activation device ~~(not shown further)~~ for activation of the electric parking brake, so that the electric parking brake is activated beginning with instant t1 and is fully activated at instant t2. This is illustrated in Fig. 2 by a line B, which rises from instant t1 to instant t2. The electric parking brake then stays in the activated (engaged) state. A time span that corresponds to the interval between instant t0 and instant t3 at which engine control device 10 initiates the switch-off of drive motor 3 is predefined in engine control device 10 (for ~~instance~~ **example**, programmed). As indicated in Fig. 2 by a descending line M between instant t3 and instant t4, drive motor 3 is turned off only after the interval has elapsed. The interval ~~is preferably~~ **may be** selected to be greater than the maximally possible duration of the activation of the electric parking brake, plus possible intervals that are required to carry out the described control measures. For ~~instance~~ **example**, as ~~shown~~ **illustrated** in Fig. 2, a short delay occurs until the activation of the electric parking brake begins at instant t0 after ignition switch 12 has been turned off.

As an alternative, the activation device outputs a success signal to EPB control device 14 once the electric parking brake is fully activated.

Variants and further developments of the method ~~according to the present invention~~ and the device ~~according to the present invention~~ **hereof** are possible. For ~~instance~~ **example**, a deactivation device may be provided, which is able to prevent the execution of the method ~~according to the present invention~~ and/or which is able to deactivate (disengage) the already activated electric parking brake without renewed starting of the drive motor. In this ~~way~~ **manner,** it is possible, for ~~instance~~ **example**, to tow the motor vehicle even on steep terrain. The deactivation device is directly connected to EPB control device 14, for ~~instance~~ **example**, which controls the operation of the electric parking brake accordingly.

ABSTRACT

A method and a device are for activating an electric parking brake of a motor vehicle, e.g., a road motor vehicle. Initiation of a connection process is recognized for disconnecting a drive motor of the vehicle when the vehicle is parked. The electric parking brake is initially activated after the initiation of the parking step, and the drive motor is disconnected thereafter. As a result, the drive motor may be used to activate the parking brake.